CHRONIC NECK PAIN

AND

NECK MUSCLE STRENGTH

Dissertation submitted to the

TAMILNADU Dr MGR UNIVERSITY, CHENNAI

in partial fulfillment of the rules and regulations for the degree of

MD in Physical Medicine and Rehabilitation held in April 2011

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Submitted by-

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CONTENTS

CHRONIC NECK PAIN AND

NECK MUSCLE STRENGTH

Objective of the study is to assess the neck muscle strength in patients with chronic neck pain and in normal population who do not have neck pain and to compare the difference in neck muscle strength in these two groups.

This is a clinical study done in the patients of Kovai Medical Centre and Hospital, Coimbatore and students of Maruthi College, Sri Ramakrishna Vidyalaya, Coimbatore.

This study was conducted in the period during 2009 – 2011.

INTRODUCTION

Neck pain is one of the most common musculoskeletal disorders, with an estimated 1-year prevalence of 31.4% to 35.6% of adults in the general population. The course of neck pain is characterized by exacerbations and remissions and only a small part of the patients experience complete resolution of their symptoms within 1 year.

A substantial proportion of the neck pain patients will thus develop chronic neck pain. The definition of chronic pain differs between studies, in terms of either 3 or 6 months duration of complaints. Nevertheless, the estimates of their one year prevalence in the general population are similar: 8.7% to 17.8% for the 3-months definition, and 8% to 13.8% for the 6-months definition.

Neck Pain and Neck Muscles

The various neck muscles are often implicated in a great number of cervical pain syndromes. The muscles in the neck may be completely or partially causative or contributory to the symptomatic expression. There is no doubt that muscular pain in the neck is the most common of all chronic issues suffered by patients and is also the most difficult to permanently resolve using traditional medical or complementary medical modalities.

When a person has non-specific pain, imaging techniques like X-rays or MRIs are not helpful in identifying the problem. This is because visible physical changes to the bones and tissues of the neck are common even in people without pain and people with pain might not show visible

changes at all. Rather than targeting a specific problem, treatment for neck pain focuses on relieving symptoms and avoiding disability.

Various studies have indicated that the Neck Muscles are important in supporting and protecting the cervical spine. Chronic neck pain leads to weakness of neck muscles and we see in our care of the person's neck pain regular and scientific neck exercises improves the symptoms.

OBJECTIVES

There is not much scientific evidence to support the standard treatments of neck pain (including things like hot and cold packs, ultrasound and massage.) The aim of this study is to assess the neck muscle strength in chronic neck pain patients and in control group and compare the difference in these two groups.

This study will give an idea of the difference if at all present in neck muscle strength in these two groups. This also may give an indication of the necessity to improve the neck muscles in the neck pain group.

This study is done in our population with the gadgets locally available to know the muscle strength in Indian patients with neck pain.

CHRONIC NECK PAIN CAUSES

Spine is a dynamic structure. Pain is produced when there is an abnormal and repetitive stress on a normal spine or normal stress on an abnormal or unexpected spine. Motion structures interact intimately. Changes in one structure, inevitably affects the other structure.

There are several possible causes of neck pain, although it is often difficult to know with certainty what is causing pain. This is because the examinations, and even imaging tests, are not able to easily differentiate among the various causes.

Cervical strain — Cervical strain may result from the physical stresses of everyday life, including poor posture, muscle tension from psychologic stress or poor sleeping habits and cervical muscle weakness. This mechanical pain presents with, stiffness, and tightness in the upper back or shoulder, last for 6 weeks.

Cervical spondylosis — is due to wear and tear of the cervical spine. This leads to narrowing of the disc space, and bone spurs.

The symptoms include neck pain or weakness, numbness of the arms or shoulders, headaches, or limited neck movement. This also can lead to spondylotic myelopathy.

Cervical discogenic pain — is caused by degeneration of the cervical intervertebral discs. The symptoms are pain with neck movements or when driving, reading, or working at a computer. Discogenic pain can also refer pain into the arm or shoulder.

Cervical facet syndrome — is common in whiplash-related neck pain and in jobs when neck extended repeatedly. The symptoms are pain in the middle or side of the neck; or in the shoulders, around the scapula, at the base of the head, or in one arm.

Whiplash injury — is caused by a traumatic event with an abrupt forward/ backward movement of the cervical spine as in a motor vehicle accident. Symptoms of whiplash include severe pain, spasm, and loss of range of motion in the neck.

Cervical myofascial pain — Myofascial pain in the neck can develop after trauma or with other medical conditions, such as psychologic stress, depression, or insomnia.

Diffuse skeletal hyperostosis — there is abnormal calcifications in the ligaments and tendons along the cervical spine. Some develop stiffness, loss of mobility, and pain.

Cervical radiculopathy — the signs include pain, weakness, or changes in sensation in the arms. This results from degenerative changes due to aging or injury and herniation of a cervical disc.

NATURAL HISTORY OF CHRONIC NECK PAIN

Most, 95% recover in 6 weeks, with or without therapy. Forty percent to 50% recover in one week and 85 to 90% in 6-12 weeks.

Sixteen percent unresponsive to treatment, and have continued disability. With specialist consultation and rehabilitation this can be reduced to 7%. This 7% need multidisciplinary care. At one year follow up 84% of all such patients improve.

Recurrence – 70-90% - at 1-2 year follow up 44% present with chronic back pain.

The prevalence of neck pain at any point in time is approximately 9% [1]. Prevalence increases with age and is higher in women than in men [2].

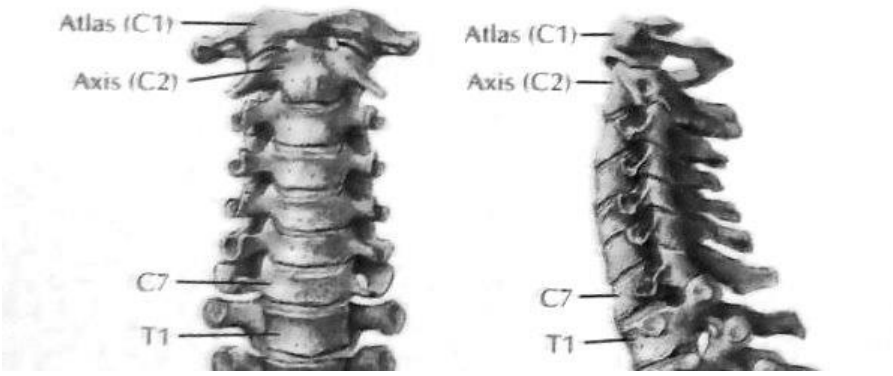
Natural progress – initial improvement in symptoms – frequent recurrences- indicates that the function has not been restored. So for many patients neck or back pain is not a self limiting illness. The care of the acute pain is easy, provided the red flags like infection, malignancy, fracture, visceral (referred) and metabolic causes are excluded.

Nordon et al– There is a small window of time in back pain care – we must act quickly within 4 to 6 weeks to bring patients to active reconditioning program. First attack is the ideal time for active and aggressive treatment. It is essential to pursue rapid restoration of symptoms aggressively to minimize the likelihood of recurrent symptoms and development of chronic disabling back pain syndrome.

This necessitates the need to assess the functional deficits of the cervical spine in which one part is the strength of the neck muscles. Assessment of the neck muscle strength will help us to treat the deficit appropriately and prevent recurring neck pain in chronic neck pain patients.

FUNCTIONAL ANATOMY

The cervical spine [Fig-1] is made up of the first 7 vertebrae and functions to provide mobility and stability to the head, while connecting it to the relative immobile thoracic spine. The first two vertebral bodies are quite different from the rest of the cervical spine. The atlas, or C1, articulates superiorly with the occiput and inferiorly with the axis, or C2. [3]



Pic – 1 Cervical Spine

The remaining cervical vertebrae, C3-C7, are similar to each other but are very different from C1 and C2. They each have a vertebral body, which is concave on its superior surface and convex on its inferior surface. On the superior surfaces of the bodies are raised processes or

hooks called uncinate processes, which articulate with depressed areas on the inferior aspect of the superior vertebral bodies called the *echancrure* or anvil. These uncovertebral joints are most noticeable near the pedicles and usually are referred to as the Joints of Luschka. These joints are believed to be the result of degenerative changes in the annulus, which leads to fissuring in the annulus and the creation of the joint.

The facet joints in the cervical spine are diarthrodial synovial joints with fibrous capsules. The facet joints in the cervical spine are innervated by both the anterior and dorsal rami.

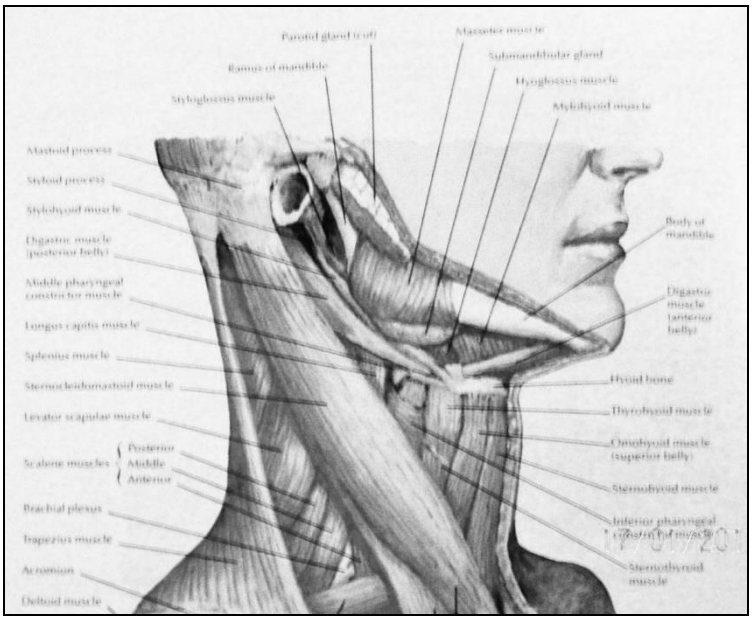
Intervertebral disks [4] are located between each vertebral body caudad to the axis. The disks are comprised of 4 parts, including the nucleus pulposus, the annulus fibrosis, and 2 end plates. The disks are involved in cervical spine motion, stability, and weight bearing.

STABILITY AND MOBILITY OF CERVICAL SPINE AND NECK PAIN

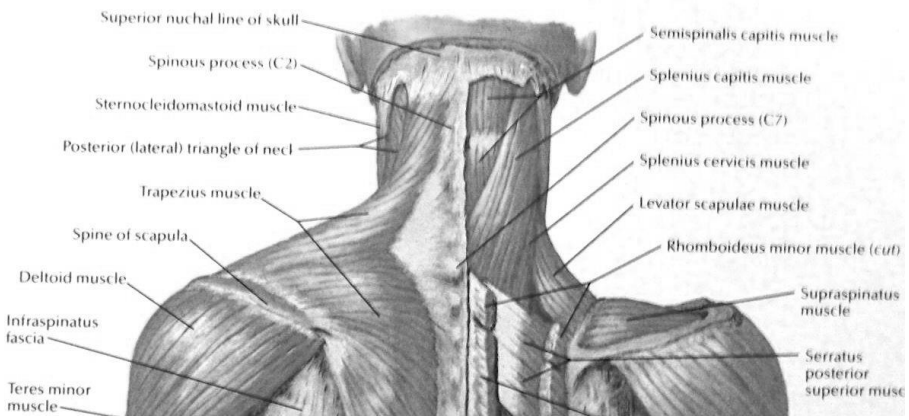
Unsupported spine collapses on axial load of 5lb.
Musculotendinous structures provide crucial support.

The anatomy of the neck is complex and is packed full of muscles, tendons, ligaments, nerves, bones, vascular tissues, lymphatic structures and other supporting tissues.

The muscular anatomy of the neck is multilayered. Here are some of the most important muscles in the neck:



PIC – 1 NECK MUSCLES ANTERIOR AND LATERAL ASPECT



PIC – 2 NECK MUSCLES POSTERIOR ASPECT

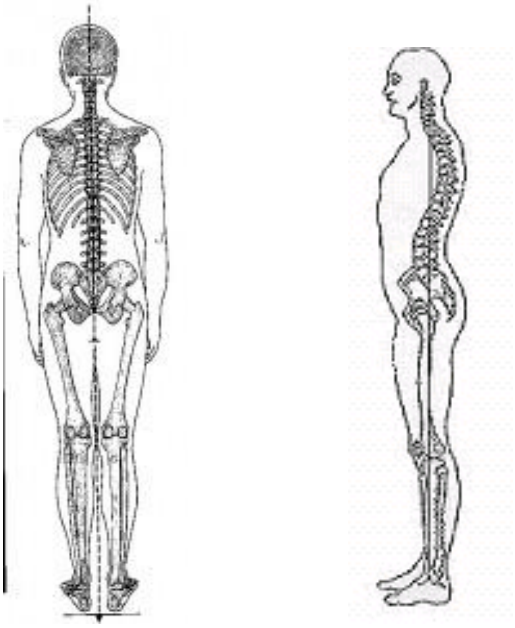
- Splenius muscle is a deep muscle attached to the base of the skull and runs down to the cervical spine. It provides extension of the head and facilitates side to side flexion and rotation of the cervical spine.
- Levator Scapulae muscle is superficial to splenius and facilitates elevation of the scapula.
- Scalene muscles consist of anterior scalene, middle scalene and posterior scalene.
- Trapezius is a major neck muscle attaching from the occiput to the thoracic spine down on either side of the vertebral column and also attaching to the scapula. The trapezius depresses, rotate and retract the scapula.

- Sternocleidomastoid muscle is superficial and regulates rotation of the head and flexion. This muscle is attached to the mastoid process and travels to its lower attachments at the sternum and clavicle on the side of the neck.
- Semispinalis muscle is a group of 3 separate muscles (semispinalis capitis, semispinalis cervicis, and semispinalis dorsi) which facilitate rotation of the upper spine and also the extension of the head and upper back. This is a deep muscle group.

NECK POSTURE

For proper posture strong and flexible neck and scapular muscles are important. Neck extensors are stronger than flexors.

Ideal Posture- [3] Ideally, the ear should be in line with the shoulder and the medial border of the scapula should be no more than 6 inches apart from each other and equidistant from the spine. Palms should face the sides of the body when standing.



PIC – 3 - IDEAL POSTURE

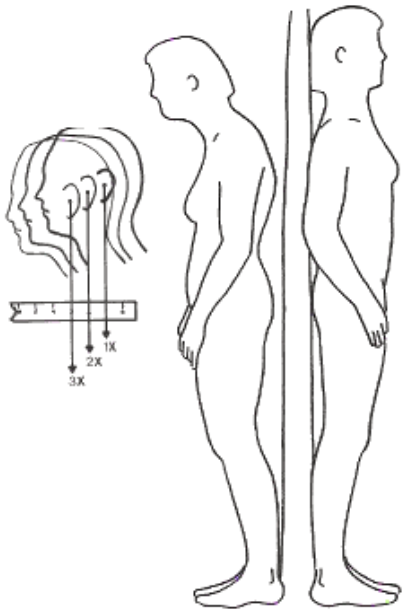
Postural Stress - the common postural stress we see in daily life are poor sleeping habits, reading or studying with the head down often, when driving, drift head forward etc. Scapular muscles are stretched, pectoral muscles shortened, leading to round back and forward and drooped shoulders.

NECK POSTURE - With increased activity of the sympathetic system, there is strong reaction in the head, neck, shoulder muscles, resulting in adoption of a typical posture. This increases the compressive forces on the lower neck, and the amount of muscular effort is required to stabilize the neck.

FORWARD HEAD POSTURE AND NECK PAIN

The head just sticks out, to the point that their head is way over their body. This is called forward head posture, or anterior head carriage.

According to Kapandji (author of Physiology of the Joints, Volume III), for every one inch that your head moves forwards, it gains 10 pounds in weight, [Pic-4] as far as the muscles in your upper back and neck are concerned.



PIC – 4 – FORWARD HEAD POSTURE

This means that they have to work that much harder to keep the head (chin) from dropping onto your chest. This also forces the suboccipital

muscles (they raise the chin) to remain in constant contraction, putting pressure on the 3 Suboccipital nerves. This nerve compression is one reason that many people suffer from headaches at the base of the skull. For example a forward neck posture of 3 inches increases the weight of the head on the neck by 30 pounds and the pressure put on the muscles increases 6 times.

In chronic neck pain poor posture strains the situation as it requires stronger muscles and resulting fatigue worsens neck pain.

"Loss of Cervical Curve stretches the spinal cord 5-7 cm and causes disease" -Dr.A.Brieg, Neuro-Surgeon

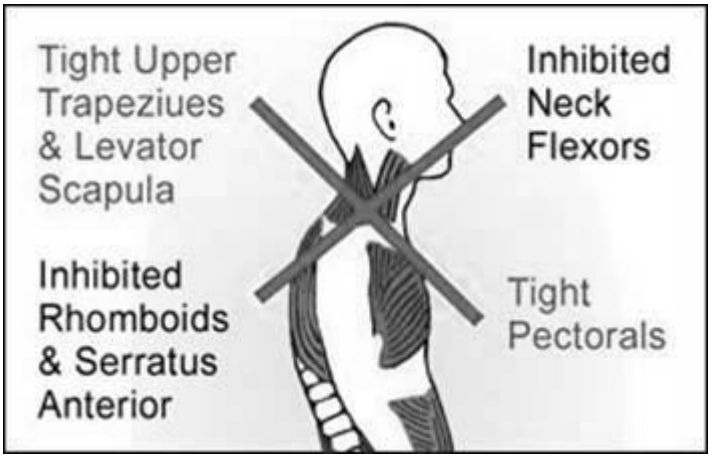
NECK PAIN AND MUSCLE IMBALANCE

According to Vladimir Janda MD – from the functional view point the following basic dysfunctions should be considered in disorders of muscles of head and neck.

MUSCLE IMBALANCE – Development of impaired relationships between muscles prone to tightness and those prone to inhibition and weakness.

ALTERED MOVEMENT PATTERN – Closely related to muscle imbalances.

Muscle tightness is commonly due to chronic overuse and the muscles maintain their strength. In the upper body the following muscles develop tightness – Pectoralis major, Pectoralis minor, upper Trapezius, Levator scapulae and sternocleido mastoid, the small muscles which tend to become tight includes massetor, temporalis, digastric and the recti and oblique connecting the occiput and cervical spine.



PIC- 5 -PROXIMAL CROSSED SYNDROME

MUSCLE IMBALANCE

Stretching the tight muscles lead to recovery of the strength and improves the activity of the antagonist muscles.

Muscles which tend to develop weakness and inhibition are lower stabilizers of the scapula – serratus anterior, Rhomboids, middle and lower Trapezius and deep neck flexors, Suprahyoid and Myelohyoid.

Since the muscle imbalance precedes the onset of pain syndrome, a thorough evaluation can be of substantial help in introducing preventive measures. The imbalance in the upper part of the body forms the Proximal Crossed Syndrome [Pic-5].

Facts about Neck Muscles

The muscular anatomy of the neck is both strong and very flexible, since both of these characteristics are crucial to facilitate the extraordinary range of motion the cervical spine and head. The head being so heavy and is placed atop a thin neck; the muscles here must be layered intricately and woven to create the structural integrity needed to support this weight throughout its extensive ROM.

Isaacson's Functional Unit - Spinal muscles are divided into two groups – one prime mover [extrinsic] and the other stabilizers [intrinsic]. The intrinsic muscles include multifidus; intertransverse, interspinal etc act as stabilizers and proprioceptive sensory receptors which facilitate the coordinated activity of the vertebral complex.

Main mass of the neck muscles, the extrinsic muscles the bulk is located in the extensor portion of the upper cervical segment – indicates the need for the strong muscle to guard against the trauma. Greatest bulk of the flexor muscles is located in the mid cervical region C45, which has

the greatest degree of mobility and is thus an area of greatest mechanical wear and tear and exposed to trauma and stress.

So the dysfunction of the muscles and joints are closely related, and both should be considered as single functional component. Improvement of joint function depends to a large extent on the improvement of the muscles related to that joint.

Limbic system dysfunction leads to musculo-skeletal pain particularly cervico cranial syndromes- shoulder neck muscle complex. Abnormal illness behavior encourages chronicity. This condition negatively affects the musculoskeletal system by promoting physical and psychological dysfunction.

REVIEW OF LITERATURE

NECK MUSCLE WEAKNESS

The feeling of "Heavy Head" in chronic neck pain is usually an indication of weakness of the muscles which support the neck and head. This weakness may arise from nerve damage, muscle damage, poor posture or repetitive activities. The muscles may be inhibited by pain or nerve problems, or fatigue may set in towards the end of an activity. Ongoing neck pain and discomfort often leads to altered or disturbed movement patterns, reduced physical activity and ultimately further neck weakness.

Acute & Chronic Neck Pain Patients can benefit from exercise.
Studies have shown that people who have osteoporosis can benefit from isometric exercises. The Study showed that muscle strength increased and so did bone mass. [5]

A study in 2002 showed that spinal manipulation therapy along with rehabilitation exercises for the neck is more beneficial than doing just spinal manipulation alone. [6]

Patients who received active management of chronic neck pain including cervical muscle endurance and coordination training and relaxation training to reduce muscle tension reported less pain, and improvements in working ability. [7]

BARTER and HAGES found isometric strength of the neck flexors in neck pain and control group in 10N and found that value was significantly lower in neck pain group. Having weak neck muscles can be a cause for certain painful conditions.

The interaction between muscles and the nervous system (neuromuscular control) may be also related to chronic pain. This suggests that pain and increased muscle activity may reinforce one another. It remains unclear whether muscle dysfunction is a cause (leading to damage of other anatomical structures) or effect (due to disuse or pain avoidance) of pain or merely an associated correlation.

According to an October 2006 *Spine* article titled “Fatty Infiltration in the Cervical Extensor Muscles and Persistent WAD: A Magnetic Residence Imaging Analysis,” there was significantly greater fatty infiltration in the neck extensor muscles, especially in the deeper muscles of the upper

cervical spine, in patients with persistent WAD, compared to healthy controls Elliott [8]

This corresponds with a J.A. Hides paper that shows lumbar multifidus atrophy and fatty infiltration when associated with a joint lesion in the lumbar spine. The Whiplash Associated Dysfunction patient needs us to restore normal joint function and rehabilitate their deep cervical stabilizer muscles.[9]

Significantly lower flexion (29%), extension (29%), and rotation forces (23%) were produced by the chronic neck pain group compared with controls [10].

A new study on women with neck pain found that specific strength training exercises led to significant prolonged relief of neck muscle pain, while general fitness training resulted in only a small amount of pain reduction [11].

The results showed that the General Fitness Training group showed a small decrease in neck muscle pain only immediately after exercise, while the Specific Strength Training group showed a marked decrease in pain over a prolonged training period and with a lasting effect after the training ended [12]. "Thus specific strength training locally of the neck

and shoulder muscles is the most beneficial treatment in women with chronic neck muscle pain," the authors state.

Another study published in the journal Arthritis & Rheumatism in 2008, also discovered that strength training targeting the neck and shoulder muscles is the most beneficial treatment for women with chronic neck muscle pain, as opposed to a general fitness routine.

Loss of Normal Neck Curve Increases Risk of Neck Pain A study in the March/Apri2005 issue of the Journal of Manipulative and Physiological Therapeutics finds that the more a person loses the normal, forward curve in the neck, the more likely they are to suffer from neck pain and related problems.

FIVE EXERCISES TARGETING CHRONIC NECK PAIN

Five specific strength exercises target same the neck and shoulder muscles involved in causing chronic neck pain. Both studies mentioned above involved the five exercises, using hand weights:

1. Dumbbell shrug
2. One-arm row
3. Upright row

4. Reverse fly

5. Lateral raise / shoulder abduction

The researchers [13] recommend performing the exercises 3 times per week (Mondays, Wednesdays, and Fridays), alternating between exercises 1, 2, and 5 on one day, and exercises 1, 3, and 4 the next.

Neck pain is a common complaint among working-aged women [14] visiting their physicians. Patients with chronic neck pain use health care services twice as much as the average population. Costs associated with neck pain are mainly from sick leave, therapy and specialist care.

180 female office workers between 25 and 53 years age experienced constant or frequently recurring neck pain for more than six months, but wanted to be rehabilitated and continue working. People who had severe diseases, psychiatric illness or were pregnant were not included.

The participants were randomly assigned into one of three groups, each with 60 patients:

1. Strength training group
2. Endurance training group
3. Control group

Groups 1 and 2 participated in a 12 day exercise program, with five 45-minute sessions per week (nine in total).

The endurance training group exercised neck muscles by repeatedly lifting the head up from a relaxed position. The strength training group pushed the neck strengthened against the resistance of a rubber band at 80% of their maximum effort. Both groups exercised the shoulders and upper arms using dumbbell and trunk and legs by squats, sit-ups and back extensions.

The control group did not complete strength or endurance training. They were advised to perform aerobic exercise 3 times a week for half an hour given training and written information about stretching exercises and were advised to stretch at home for 20 minutes three times a week were not encouraged to do strength exercises

At the 12 month the participants described their neck pain on a scale of 1 to 6 (1 indicating much more pain and 6 indicating complete relief from pain).

Study Findings:

Neck strength had improved in all groups 12 months after the training, but the strength group showed by far the most improvement and the endurance group also improved more than the controls.

In all three groups, the number of patients taking analgesics and the number of visits to a physician decreased in the year after the study began. The two exercise groups, however, showed a greater decrease.

NECK MUSCLE WEAKNESS IN CHRONIC NECK PAIN

The above referred literature clearly indicates relationship of chronic neck pain and neck muscle weakness. Many factors contribute to neck pain. In most persons, the precise cause of the pain is unknown. In this study we are assessing the neck muscle strength which may be one of the causes or perpetuating factor in chronic neck pain patients.

MATERIAL AND METHOD

In this study we assessed the cervical spine muscle strength in persons with chronic neck pain and in control group without history of neck pain. With this data the strength of the neck muscles are compared and the difference in muscle strength is found out.

SELECTION OF THE SUBJECTS

It is well known that the acute pain inhibits the muscle contraction. In this study only patient who is totally pain free is taken up for the study. These are the patients who have chronic pain for more than six months and they are in remission during the evaluation. They should not have any organic lesion, fracture, infection, post operative problems.

From all the persons consent to join in the study is received.

METHODOLOGY

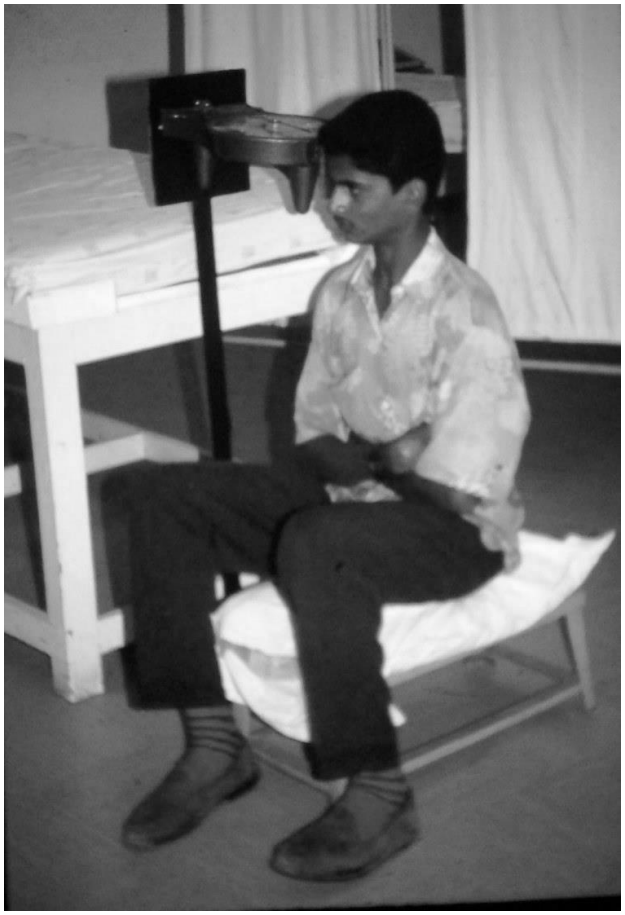
Isometric neck muscle strength is assessed in sitting posture. A spring balance [Pic – 6] was mounted on a stand and the height is fixed. According to the height of the subject the stool height is adjusted.

Pic 6 – Balance Mounted On Frame

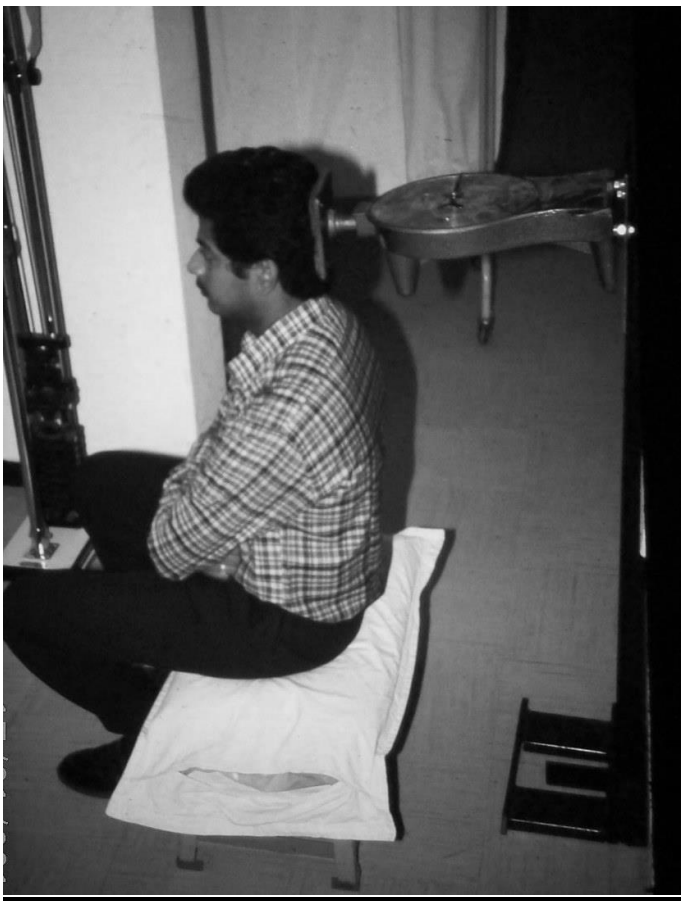
NECK MUSCLE STRENGTH of the flexors, extensors and right and left lateral flexors assessed. First the subject is explained about the procedure. Subject is well seated and the body is stable. The surface of the head should be on the balance weighing area in erect sitting. Arms folded in front of the body. He or she has to try for a few times. Then the subject does the effort three times. The highest resistance given is taken as the reading. On two repetitions the same reading should be done.

To check the lateral flexors the person seated the balance weighing area is on the lateral surface of the head [Pic – 7]

To check the extensors of the neck the person seated the balance weighing area is on the posterior surface of the head [Pic – 8]



Pic –7- PERSON TESTING LATERAL FLEXORS



Pic –8 - PERSON TESTING EXTENSORS

The shoulder elevators are assessed with a Salter Dynamometer [Fig-9]. This Dynamometer is fixed on a heavy stand, on which subject has to stand and pull the handles up with the extended elbow by rising the shoulder[Fig-10]. The length of the chain attached to the handle is adjustable according to the height of the subject. The method of effort to be put forth is explained to the subject. Here again he or she has to try for a few times. Then the subject does the effort three times. The highest

resistance pulled is taken as the reading. On two repetitions the same reading should be done.

PIC-9- SALTER DYNAMOMETER

PIC-9 - PERSON TESTING SHOULDER ELEVATOR

STUDY GROUP

Neck muscle strength is assessed in 110 subjects. This includes neck pain group of 30 nos and control group with no neck pain 80 nos.

Neck pain group should be suffering from chronic neck pain. Pain group should not have any acute pain, as this will inhibit muscle contraction. They should be in the remission period so that they can cooperate during the muscle strength assessment.

No neck pain group is further divided into control active group or control sedentary group. The active group is persons who are athletes playing foot ball, kabadi, basket ball, cricket, volley ball or on regular active exercise programs. The sedentary group is on sedentary job and they do not go for any exercise program or games.

All the persons were after initial evaluation if found to fulfill the criteria and after getting their consent participated in the study.

RESULTS

The assessment details are tabulated as neck pain group and active group and the results are evaluated.

TABLE I – NECK PAIN GROUP

Assessment Results

No		Should	Elev	Cerv	Spine	Lateral	Flex	Neck
	Age	Right	Left	Flex	Ext	Right	Left	Circumf
P-1	28	50	35	6.5	20	7.5	11	37
P-2	31	46	46	5.6	14.8	7.15	7.47	35.2
P-3	23	40	50	5.5	14	7	8.5	34
P-4	30	47	47	6.6	15.8	8.15	8.47	35
P-5	40	50	45	7	11	9.5	10.5	35.5
P-6	30	45	46	6	14	6.5	7	34
P-7	27	45	50	6	18	6	6	34
P-8	31	46	45	5.6	15	7.2	7.5	35
P-9	30	50	50	6.5	17.5	4.5	4	36.5
P-10	28	45	45	5.5	16.5	6.5	6.5	34.5
P-11	29	44	43	4.6	13.8	6.2	6.5	33.2
P-12	26	35	35	6.5	14	6.5	6	37.5

P-13	32	48	47	6.6	15.8	8	8	37
P-14	35	60	50	5	20	11	8	32.5
P-15	27	49	48	6.6	15.8	8.2	8.5	37
P-16	34	43	42	5	14	7	6.5	33
P-17	44	35	40	3	13	6	6	38.5
P-18	42	35	35	2.5	11	7	8	27
P-19	30	47	46	5.6	14.8	7	7.1	35
P-20	32	45	45.2	5.6	14.5	7.3	7.9	35.4
P-21	24	35	30	4.5	9	6	5.5	3517
P-22	17	80	75	6.5	12	13.5	14	38.5
P-23	35	30	30	6	10	5	5.5	35
P-24	36	35	40	5	18	5	3	35.5
P-25	34	60	55	7.5	18.5	9.5	10	39
P-26	35	45	50	8.5	18	10	11	35.5
P-27	23	45	50	5	13	4	5.5	32.5
P-28	30	55	65	7	20	7.5	9	38
P-29	24	50	50	3	6.5	4.5	5.5	33
P-30	30	40	35	5	16	6.5	6	36.5

TABLE II – CONTROL GROUP –

Sedentary Assessment Results

		Shoul d	Elev	CERV	SPINE	LAT	FLEX	NECK
No	Age	Right	Left	FLEX	EXT	Right	LEFT	Circumf
S-1	23	65	55	5.5	13	5.5	3.5	33.5cm
S-2	23	85	70	6.5	18	6	8	36.5
S-3	19	55	40	3	16	4	9.5	32
S-4	28	35	35	3.5	13.5	7	8	33.5
S-5	28	50	30	6.5	19.5	4.5	5.5	35
S-6	21	55	60	4.5	14.5	5.5	4.5	34
S-7	25	55	50	7	17	4	5	36.5
S-8	25	45	55	7.5	15.5	6	8.5	37.5
S-9	26	30	30	6	11	8	9	33.5
S-10	23	40	30	7	17	6	6	38.5
S-11	25	60	50	6.5	16	9.5	7	36
S-12	24	50	50	5	17	6	11	32.5
S-13	26	50	45	5.5	18	7	9	35.5
S-14	25	60	60	8	17	8	8	38
S-15	24	50	35	9	18	9	13	34.5
S-16	23	30	30	9	20	6	8	30.5
S-17	27	45	40	6	20	8	7	36
S-18	29	20	25	5	16	12.5	14	35.5

S-19	21	40	30	3.5	13	7.5	8.5	34
S-20	22	40	40	5	9.5	6	6.5	34.5
S-21	25	70	60	4	17	5.5	6	31.5
S-22	23	70	55	6	12.5	9.5	8.5	32.5
S-23	19	50	40	4	13	6	9.5	33
S-24	37	40	30	6	14	7.5	7	34
S-25	25	35	40	6	16	7	6	33.5
S-26	22	76	65	6.5	16	10	9	33
S-27	22	60	40	8	12.5	6.5	9	35
S-28	25	50	45	9.5	18.5	8.5	8.5	36
S-29	25	50	40	5	10	7	3	35
S-30	30	60	50	10	14	9	10	36
S-31	35	60	55	9	18	10	12.5	35
S-32	35	55	55	4	18.5	7	10	33.5
S-33	25	60	60	6	13	4	4	33.5
S-34	29	55	50	6	20	7	8	37
S-35	25	55	60	6.5	15	4.5	5.5	36
S-36	25	55	60	6.5	15	4.5	5.5	36
S-37	26	50	45	5.5	18	7	9	35.5
S-38	29	20	25	5	16	12.5	14	35.5
S-39	30	60	50	10	14	9	10	36
S-40	29	55	50	6	20	7	8	37

TABLE III – CONTROL GROUP –

Active Persons - Assessment Results

No		Should	Elev	Cerv	Spine	Lat	Flex	NECK	Activity
	AGE	Right	Left	FLEX	EXT	Right	Left	Circumf	
A-1	23	60	40	5.5	20	12	12.5	33.5	
A-2	26	50	60	6	14	12	11	37.5	
A-3	32	60	70	10.5	20	11.5	12.5	37.5	
A-4	25	60	50	5	19	10	12	37.5	
A-5	22	40	60	7	20	9	9.5	37.5	
A-6	27	55	50	11	20	11	14	34	Foot ball
A-7	26	60	40	10	20	6	7	36.5	Crickt
A-8	27	60	60	6	20	10	11	33	
A-9	23	50	45	7	17	8	9	36	VolBal
A-10	22	60	70	10	19	9	14	30.5	VolBal
A-11	27	50	60	8	17	8	9	40.5	Kabadi
A-12	23	30	50	7	20	6	9.5	37.5	Hockey
A-13	21	45	40	6	20	7.5	8.5	33.5	Kabadi
A-14	26	55	45	7	20	7.5	9	37.5	Kabadi
A-15	26	80	65	7	20	10	18	37.5	Crickt
A-16	24	70	50	7	20	10.5	7.5	35.5	VollBal
A-17	28	60	65	6.5	20	9.5	12.5	38	Kabadi
A-18	24	70	60	13	20	13.5	17	40	VolBal
A-19	24	60	50	10	20	8	11	37.5	FotBal

A-20	23	60	55	7	14.5	8.5	12	36	Athlt
A-21	26	50	45	9	20	8	14	35.5	FotBal
A-22	24	50	55	8	20	10	12	36.5	BaskBal
A-23	23	60	50	10	20	11	13	35.5	BaskBal
A-24	21	60	55	9	18	15	15	34.5	Crickt
A-25	20	40	30	9	13	10	13	34.5	VollBal
A-26	19	65	65	5.5	20	14	16.5	38	
A-27	30	45	45	9	20	13.5	15	36.5	
A-28	31	45	55	14	20	20	20	38	WtLift
A-29	27	55	45	13	20	16	11	40	WtLift
A-30	33	55	50	7	20	15.5	15.5	40	WtLift
A-31	27	55	55	11	20	15	20	41.5	WtLift
A-32	27	70	75	8.5	20	14.5	14.5	42.5	WtLift
A-33	23	45	45	8.5	20	10	12	37.5	Kabadi
A-34	23	50	40	11.5	20	17	18.5	36.5	Kabadi
A-35	25	65	60	7	20	11	15	38	VollBal
A-36	25	35	40	7	17	10	10.5	35.5	
A-37	23	50	50	9	17	10	12.5	35.5	
A-38	28	65	60	8	15.5	9	11.5	33.5	
A-39	24	75	60	5	20	9.5	9.5	35.5	
A-40	27	60	55	6	20	11	15	35	

TABLE IV - NECK PAIN GROUP - RESULTS

	AGE	SHOULD	ELEV			LAT	FLEX	Circumf
		RIGHT	LEFT	FLEX	EXTENSION			
No	30	30	30	30	30	30	30	30
S.D.	7	11.76	11.38	1.54	4.02	2.43	2.75	2.77
P.SD.	6.82	11.46	11.09	1.50	3.92	2.37	2.68	2.70
Mean	30.55	46	45.79	5.6	14.8	7.15	7.47	35.2

DISCUSSION

This table [Table V] compares the muscle strength in pain group and control group with out neck pain.

TABLE V - NECK PAIN GROUP – CONTROL GROUP –

COMPARATIVE RESULTS

	AGE	SHOULDER	ELEV			LAT	FLEX	Circum	
		RIGHT	LEFT	FLEX	EXTENSION	Right	Left		No
PAIN GROUP	30.55	46	45.79	5.6	14.8	7.15	7.47	35.2	30
CONTROL GROUP	25.4	53.38	49.43	7.25	17.32	9.03	10.42	35.2	80

The mean age of the pain group is higher when compared to the no pain group. It is 30.55 in pain group and 25.42 in the control group.

The shoulder elevators on the right side in the pain group were 46 Kg and in the control it was 53.38 Kg. On the left side in the pain group it was 45.79 Kg and in the control group it was 49.43 Kg.

This clearly indicates that the shoulder elevators are weaker in the pain group. In both groups right side muscles are stronger.

The strength of neck flexors is 5.6 Kg in the pain group and 7.25 in the control group.

The strength of neck extensors are 14.8 in the pain group and 17.32 in the control group.

This clearly shows that the neck flexors and extensors are weaker in the pain group when compared to the control group. Another informative finding was that the strength of neck extensors is more than twice that of neck flexors.

The right and left lateral flexors in the pain group was 7.5 Kg and in the control group it was 9.8 Kg on the right and 10.4 Kg on the left side. This also shows that the lateral flexors are weaker in the pain group.

There is no difference in the neck circumference.

These tables [Table VI and VII] compare the muscle strength between the sedentary and active in the control group.

TABLE VI - CONTROL SEDENTARY GROUP - RESULTS

	AGE	SHOULD	ELEV			LAT	FLEX	Circumf
		RIGHT	LEFT	FLEX	EXTENSION			
No	40	40	40	40	40	40	40	40
S.D.	3.99	13.4	11.92	1.78	2.85	2.07	2.6	1.79
P.SD.	3.94	13.23	11.77	1.76	2.82	2.04	2.58	1.77
Mean	25.72	51	45.87	6.22	15.61	7.125	8.06	34.8

Table VII - CONTROL ACTIVE GROUP - RESULTS

	Shoulder	elevation	Cervical	Spine	Lateral	Flexion
	Right	Left	Flex	Extension	Right	Left
No	40	40	40	40	40	40
S.D.	10.53	9.79	2.26	1.89	3.08	3.25
P S.D.	10.4	9.67	2.23	1.867	3.04	3.2
Mean	55.75	53	8.28	19.02	10.93	12.78

Shoulder elevators were 51 Kg on the right and 45.87 Kg on the left in the sedentary group and 55.75 Kg on the right and 53 Kg on the left in the active group.

In sedentary group shoulder elevators are weaker.

In both groups the right was stronger than the left.

The neck flexors were 6.22 Kg in the sedentary group and 8.28 Kg in the active group.

The neck flexors are weaker in sedentary group.

The neck extensors were 15.61 Kg in the sedentary group and 19.02 Kg in the active group.

This shows that the neck extensors are stronger than neck flexors and further that the sedentary group had weaker muscles.

The lateral flexors are 7.1 Kg on the right and 8.06 Kg on the left side in the sedentary group and 10.93 Kg on the right side and 12.78 Kg on the left side in the active group. The lateral flexors are stronger on the left side. This table also clearly shows that the sedentary group has weaker neck muscles.

SUMMARY

- Neck muscles are weaker in Chronic Neck Pain patients
- Neck extensors are more than two times stronger than flexors
- In the control group the neck muscles are stronger in the active group. The sedentary people in the control group have weaker muscles
- The lateral flexors are stronger on the left side

CONCLUSION

1. In Chronic Neck Pain patients due to their weak neck muscles the protection to the cervical spine is less to prevent further injury during stressful situations. So they require regular and specific neck muscle strengthening exercise to prevent recurrence of symptom. These specific cervical exercises strengthen the spinal muscles and provide better support by spinal bracing.

2. The role of cervical brace is also important. They may be used in situations where the person with chronic neck pain is subjected to prolonged stresses as in occupation or while traveling.

3. The sedentary people in the control group were found to have weaker muscles. Are they prone to neck pain ?
Only long term study can prove this aspect of finding.

Follow up - All the Chronic Neck Pain patients were given a program of exercise. The neck pain feed back form is also given to them. Follow up in future will confirm the usefulness of the exercise in preventing frequent recurrences.

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Appendix

NECK DISABILITY INDEX

SECTION 1--Pain Intensity

- I have no pain at the moment
- The pain is mild at the moment
- The pain comes and goes and is moderate
- The pain is moderate and does not vary much
- The pain is severe but comes and goes
- The pain is severe and does not vary much

SECTION 2 -- Personal Care (Washing, Dressing, etc.)

- I can look after myself without causing extra pain
- I can look after myself normally but it causes extra pain
- It is painful to look after myself and I am slow and careful
- I need some help, but manage most of my personal care
- I need help every day in most aspects of self-care
- I do not get dressed; I wash with difficulty and stay in bed

SECTION 3 -- Lifting

- I can lift heavy weights without extra pain
- I can lift heavy weights, but it causes extra pain
- Pain prevents me from lifting heavy weights off the floor but I can if they are conveniently positioned, for example on a table
- Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
- I can lift very light weights
- I cannot lift or carry anything at all

SECTION 4 -- Reading

- I can read as much as I want to with no pain in my neck
- I can read as much as I want with slight pain in my neck
- I can read as much as I want with moderate pain in my neck
- I cannot read as much as I want because of moderate pain in my neck

- I cannot read as much as I want because of severe pain in my neck
- I cannot read at all

SECTION 5 -- Headache

- I have no headaches at all
- I have slight headaches which come infrequently
- I have moderate headaches which come infrequently
- I have moderate headaches which come frequently
- I have severe headaches which come frequently
- I have headaches almost all the time

SECTION 6 -- Concentration

- I can concentrate fully when I want to with no difficulty
- I can concentrate fully when I want to with slight difficulty
- I have a fair degree of difficulty in concentrating when I want to
- I have a lot of difficulty in concentrating when I want to

- I have a great deal of difficulty in concentrating when I want to
- I cannot concentrate at all

SECTION 7 -- Work

- I can do as much work as I want to
- I can only do my usual work, but no more
- I can do most of my usual work, but no more
- I cannot do my usual work
- I can hardly do any work at all
- I cannot do any work at all

SECTION 8 -- Driving

- I can drive my car without neck pain
- I can drive my car as long as I want with slight pain in my neck
- I can drive my car as long as I want with moderate pain in my neck
- I cannot drive my car as long as I want because of moderate pain in my neck

- I can hardly drive my car at all because of severe pain in my neck
- I cannot drive my car at all

SECTION 9 -- Sleeping

- I have no trouble sleeping
- My sleep is slightly disturbed (less than 1 hour sleepless)
- My sleep is mildly disturbed (1-2 hours sleepless)
- My sleep is moderately disturbed (2-3 hours sleepless)
- My sleep is greatly disturbed (3-5 hours sleepless)
- My sleep is completely disturbed (5-7 hours sleepless)

SECTION 10 -- Recreation

- I am able to engage in all recreational activities with no pain in my neck at all
- I am able to engage in all recreational activities with some pain in my neck
- I am able to engage in most, but not all recreational activities because of pain in my neck

- I am able to engage in a few of my usual recreational activities because of pain in my neck
- I can hardly do any recreational activities because of pain in my neck
- I cannot do any recreational activities all

The Neck Disability Index was developed in 1989 by Howard Vernon. The Index was developed as a modification of the Oswestry Low Back Pain Disability Index with the permission of the original author (J. Fairbank, 1980). In 1991, Vernon and Minor published the results of a study of reliability and validity in the Journal of Manipulative and Physiologic Therapeutics. Since then, many articles have appeared in the indexed literature on the Neck Disability Index. All of these studies have confirmed the original reports of a high level of reliability and validity. The minimum detectable score and the minimal clinically important difference amounts to the same figure - 5 Neck Disability Index points.

The Neck Disability Index has become a standard instrument for measuring self-rated disability due to neck pain and is used by clinicians and researchers alike.

Each of the 10 items is scored from 0 - 5. The maximum score is therefore 50. The obtained score can be multiplied by 2 to produce a percentage score.

The original report provided raw scoring intervals for interpretation, as follows:

0 - 4 = no disability

5 - 14 = mild disability

15 - 24 = moderate disability

25 - 34 = severe disability

above 34 = complete disability.

It is recommended that the Neck Disability Index be used at baseline and for every 2 weeks thereafter within the treatment program to measure progress. As noted above, at least a 5-point change is required to be clinically meaningful. Patients often do not score the items as zero, once they are in treatment. In other words, it is common to find that patients will continue to score between 5 - 15 despite having made excellent recovery (i.e., they may be back to work). The practitioner should avoid the trap of "treating till zero", as this is not supportable based on current evidence.